

## **Military Uses of Space: 1946-1991**

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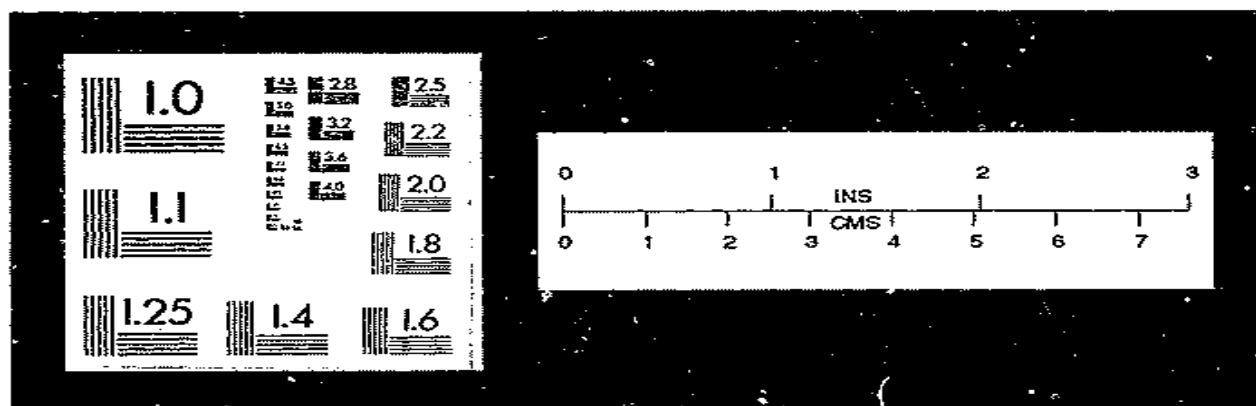
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| <b>Planned</b>      |           |
|---------------------|-----------|
| <b>DMSP / SDIO</b>  | <b>4</b>  |
| <b>Classified</b>   | <b>6</b>  |
| <b>NOAA (TIROS)</b> | <b>3</b>  |
| <b>LANDSAT 6</b>    | <b>1</b>  |
| <b>Total</b>        | <b>14</b> |

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## **Titan II Excess Launch Capacity**

**Current contract funds three Titan II launches per year through 1995**

- Titan II launch capacity in excess of three launches per year is achievable with minimal manpower costs
- Additional Titan launches can be added for small refurbishment costs
- Launch facilities and equipment capability exists to support five launches per year

| <b>CY</b>                 | <b>1988</b>   | <b>1989</b> | <b>1990</b> | <b>1991</b> | <b>1992</b> | <b>1993</b> | <b>1994</b> | <b>1995</b> |
|---------------------------|---------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Launch Capacity</b>    | 2             | 5           | 5           | 5           | 5           | 5           | 5           | 5           |
| <b>Current Launches</b>   | ←—————14————→ |             |             |             |             |             |             |             |
| <b>Available Launches</b> | ←—————23————→ |             |             |             |             |             |             |             |

**Titan II can support additional near-term launches**

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# **Titan II Summary**

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**Titan II program development and refurbishment progressing with no major problems**

- September 5, 1988 successful launch
- Three launches per year in existing contract
- Current mission model identifies only one or two launches per year
- Additional launches possible for essentially the cost of hardware

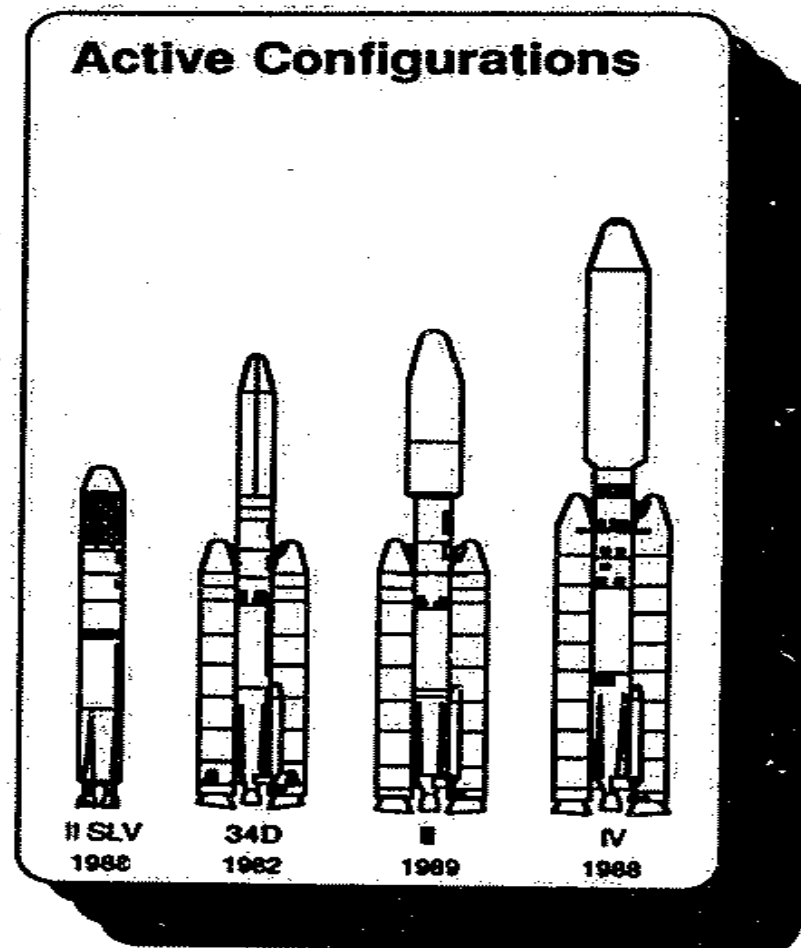
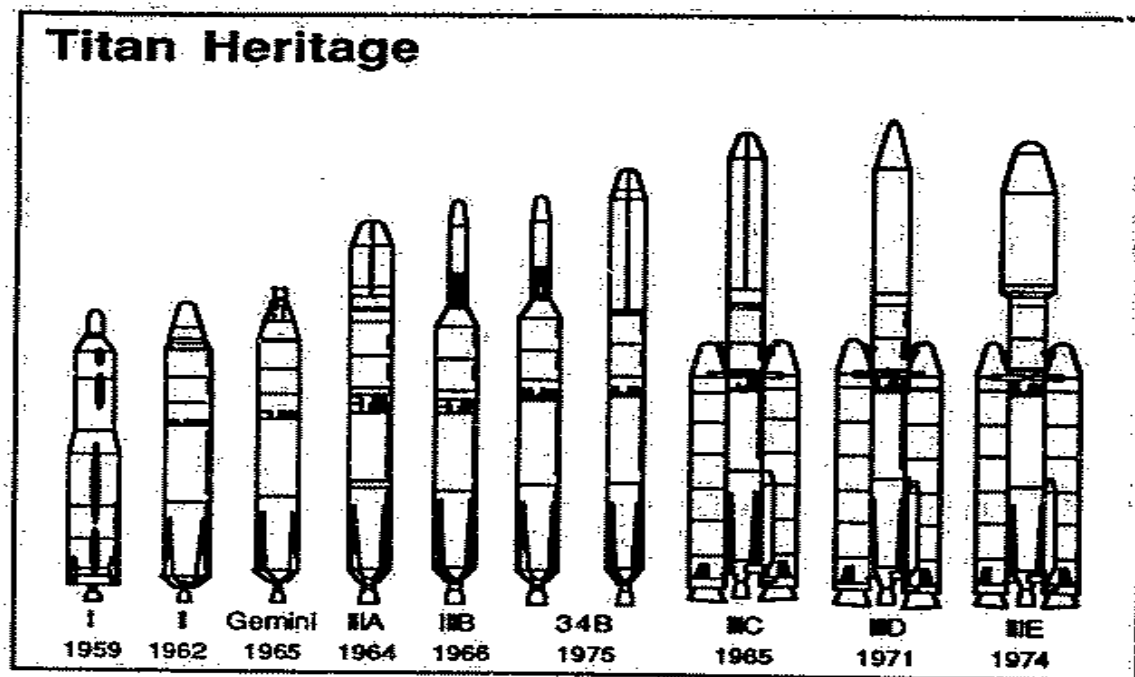
**Titan II represents low cost launch vehicle for government payloads**

- New initiatives underway to increase Titan II user benefits
  - Cost reduction efforts
  - Performance enhancement studies
- Air Force offering Titan IIs as a national asset to all government users

# Commercial Titan

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# Titan Launch Vehicle Heritage



# **Space Launch Systems Summary**

## **Titan II, Commercial Titan, and Titan IV on schedule**

- Titan II — Initial launch September 5, 1988
- Commercial Titan — Launch planned 3rd quarter 1989
- Titan IV — 4th quarter 1988 Initial Launch Capability

## **Titan launch vehicle planned enhancements**

- Titan IV performance/reliability upgrades
- Titan II alternative payload fairing

## **Space Launch Complex-7 Phase I study under contract**

## **ALS Phase II winners announced**

- Contract funding expected 4th quarter 1988



# **Commercial Titan Overview**

**Customer:**

Commercial and civil government users

**Program:**

Commercial launch services

Initial Launch Capability: July 1989

**Prime Contractor:**

Martin Marietta

- Airframe
- System Integration
- Launch Services

**Principal Subcontractors:**

Contraves AG

- Payload Fairing

United Technologies

- Solid Rocket Motors

Aerojet TechSystems

- Liquid Rocket Engines

Dornier GmbH

- Payload Carrier Assembly

Delco Electronics

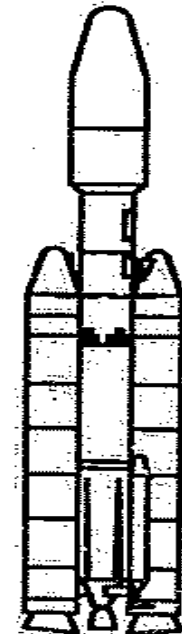
- Guidance System

SCI

- Instrumentation

Cincinnati Electronics

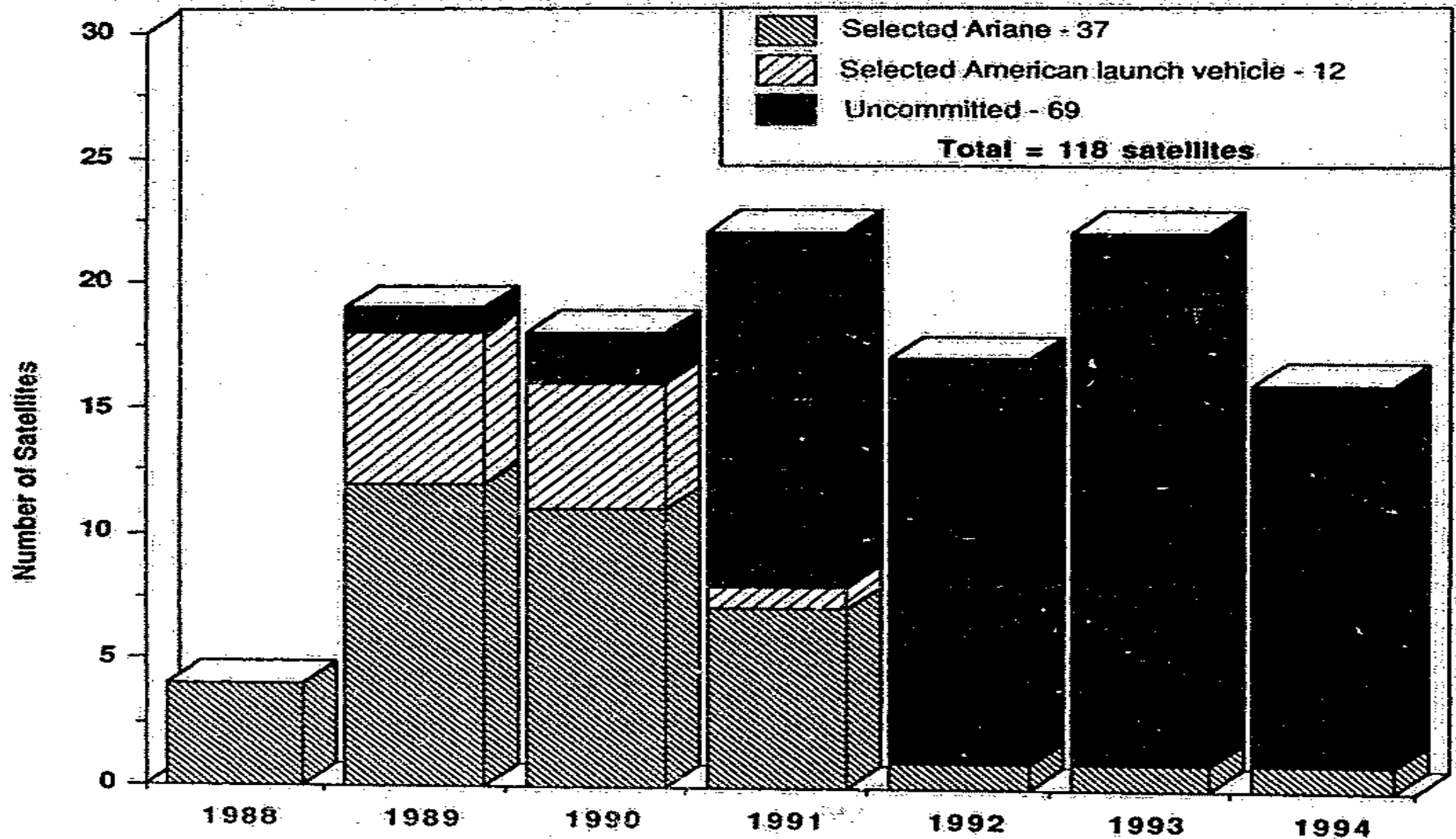
- Command Receivers



**Commercial  
Titan**

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## Projected Commercial Launch Service Requirements



# **Commercial Titan Program Summary**

## **Titan III has a proven success record**

- 137 operational missions through 1987 with 96.4% success record
- Proven reliability permits offering success warranty (reflight or refund)

## **Commercial program uses existing resources**

- Titan III launch vehicle now operational
- Minimal hardware modification required
- Existing launch complex will be used

**Existing manufacturing base permits stable, economical production well into the 1990s**

**Commercial Titan configuration flexibility supports wide range of mission requirements**

**Commercial Titan will be operational in 1989**



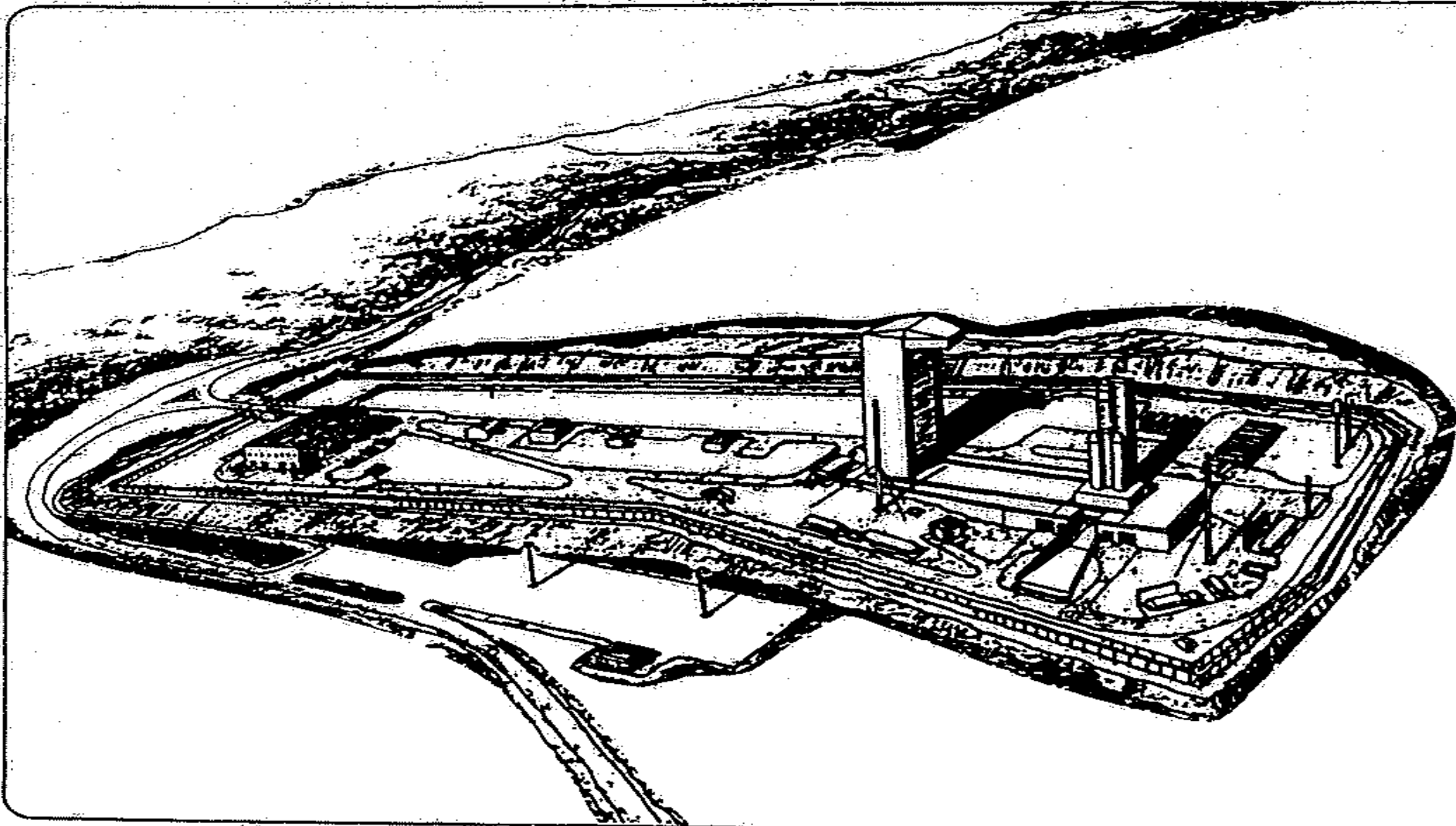
**Commercial Titan**

# **Space Launch Complex-7**

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## Space Launch Complex-7

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## **Phase II Procurement Strategy**

### **Single turnkey contract for SLC-7 acquisition**

- Includes all aerospace ground equipment design and construction/procurement
- Includes all systems engineering design, procurement and installation
- Includes systems engineering and program integration
- Includes all supporting functions — procurement, logistics, ground systems testing and support services through first launch

### **Titan IV vehicle contractor conducts launch processing**

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# **Advanced Launch System**

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# **ALS Summary**

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**Proper allocation of cost and reliability targets key to successful implementation**

- Product teams

**Clean sheet approach essential to achieve ALS objectives**

- Vehicle design
- Manufacturing and assembly
- Launch operations
- Management/business practices

**Innovative technology demonstrations identified to achieve cost objectives**

**A path to \$300/lb has been defined**

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# **Advanced Launch System (ALS) Objectives**

**"ALS is the Future for Our  
National Space Launch Capability"**

**Secretary Aldridge  
March 25, 1988**

**First,**

- Provide the launch capability if a SDI deployment decision is made

**Second,**

- Develop technologies, system designs, and operational concepts for the next generation of launch vehicles to meet requirements from the heaviest to the smallest payloads

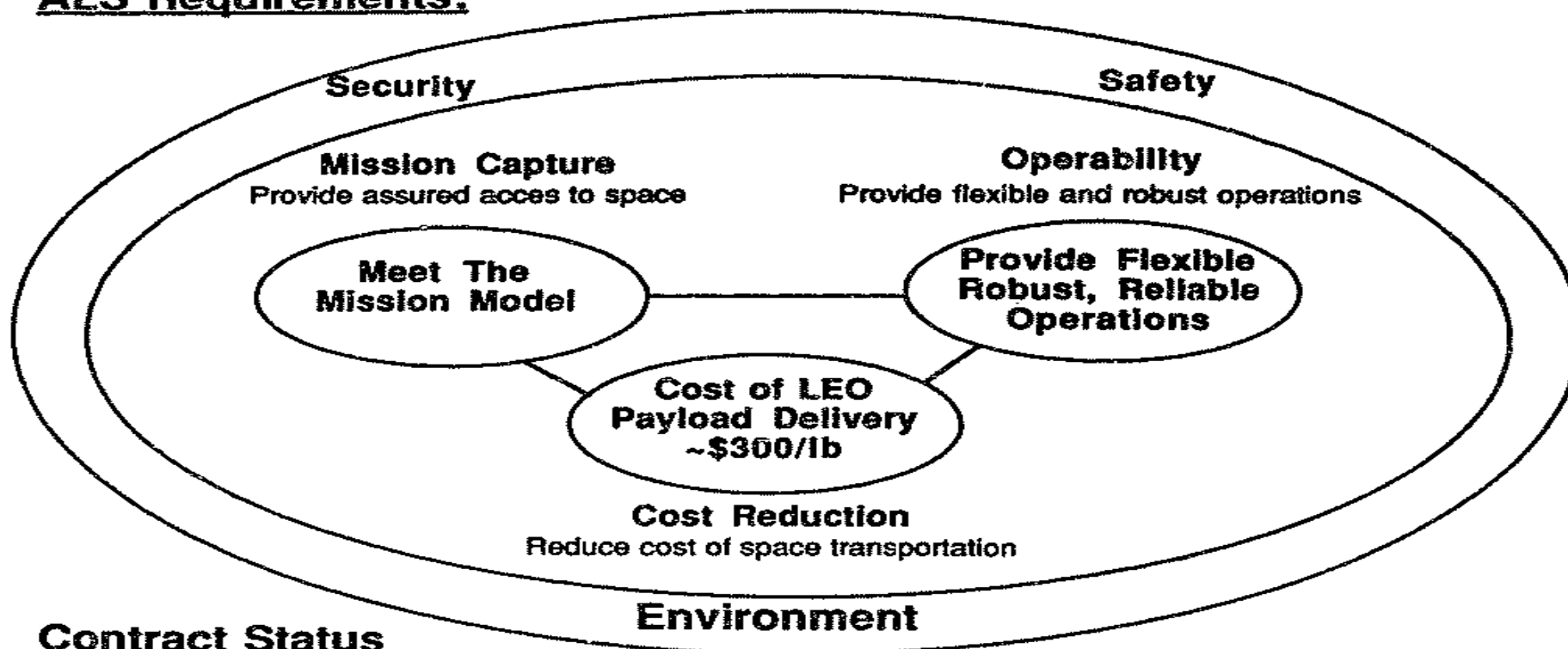
**Third,**

- Spin-off applicable ALS technology achievements to our existing launch systems

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# ALS Program Description

## ALS Requirements:

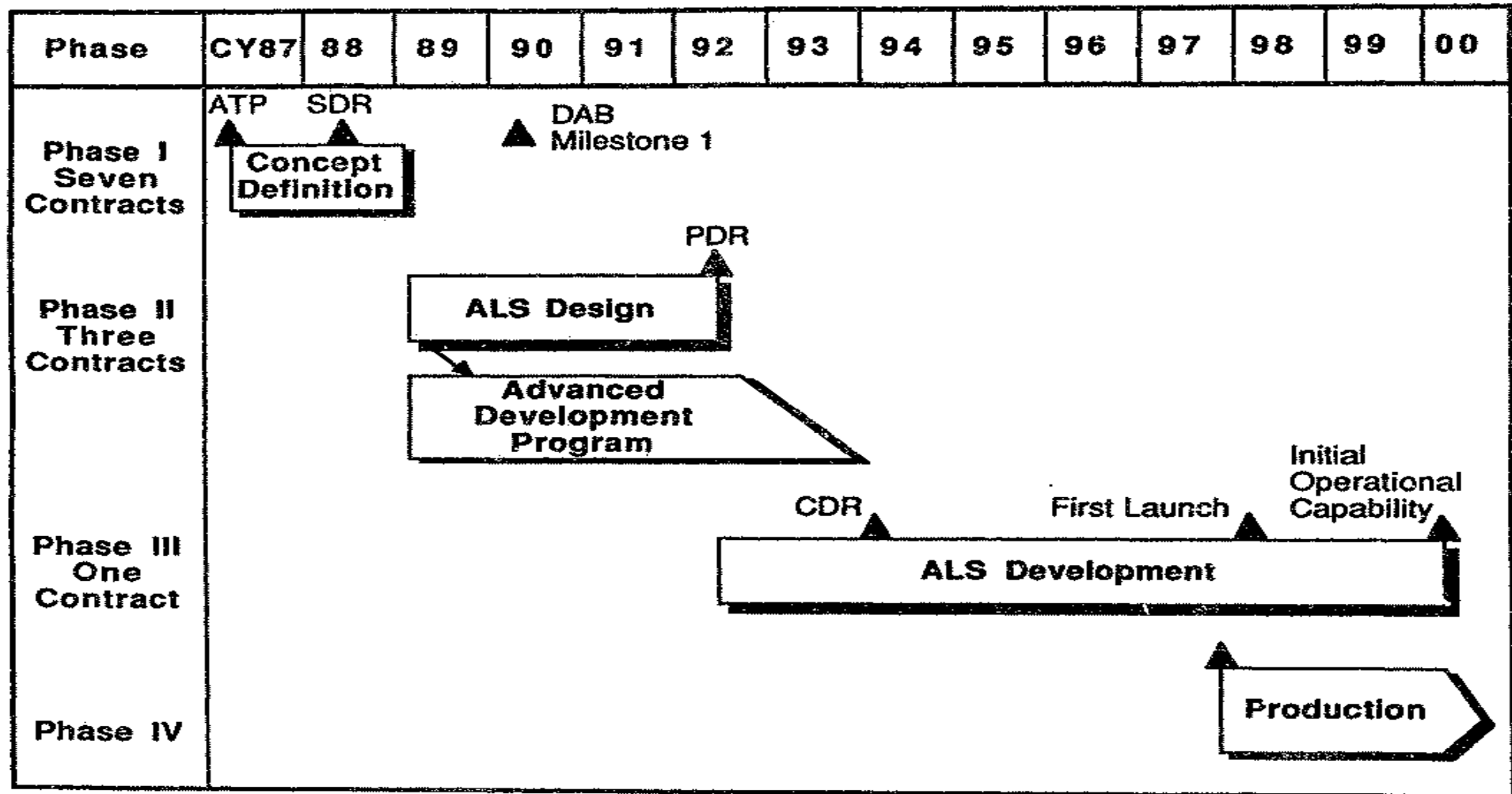


## Contract Status

Three Phase II contract winners announced in mid-August

- Martin Marietta/McDonnell Douglas
- Boeing
- General Dynamics

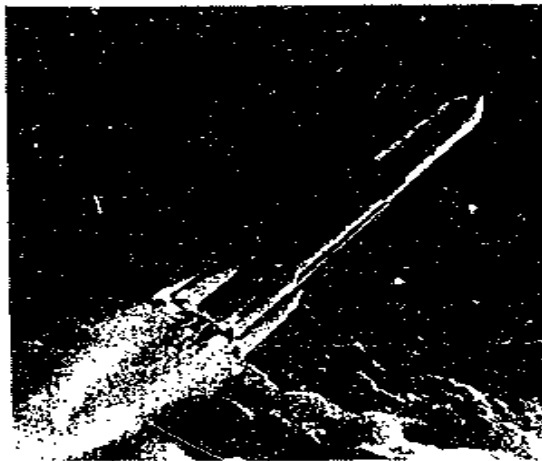
# Overall ALS Development Schedule



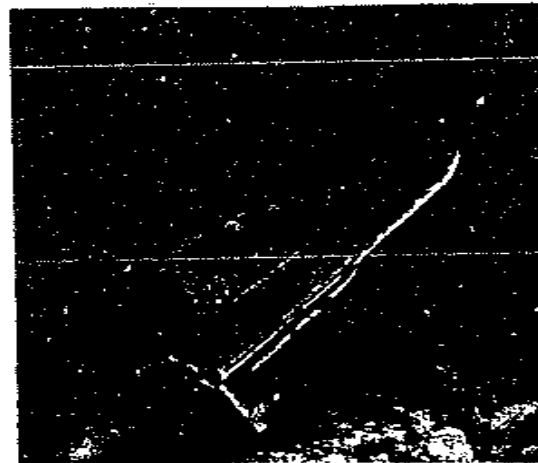
# ALS Vehicle Configurations

## Our Approach Provides Low Cost and Resiliency

- Multiple Monolithic Solids
- Fault - Tolerant Avionics
- Efficient, Low Cost Engines
- High design margins



**Expendable**

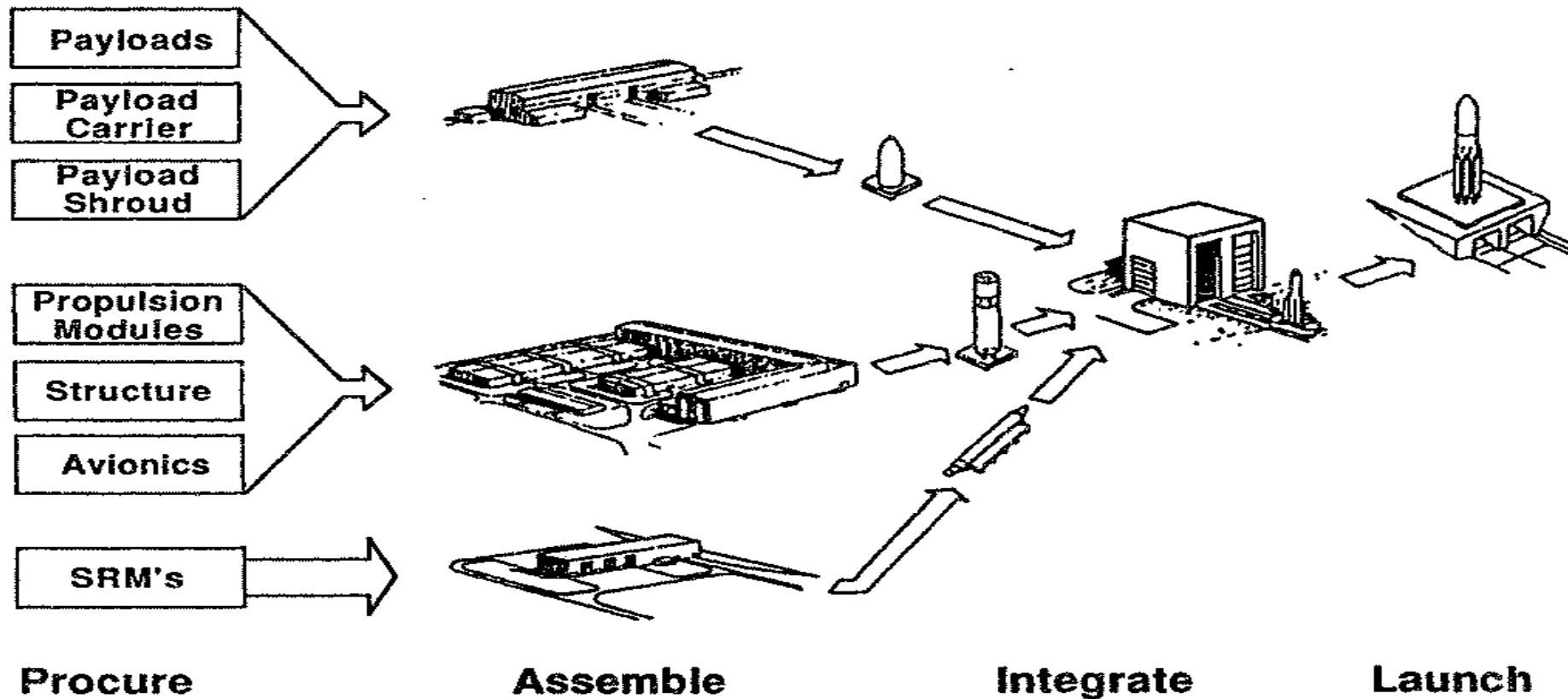


**Partially Reusable**

- Single Body Flyback Booster
- Common Engine Booster/Core
- Fault – Tolerant Avionics
- High Design Margins
- Efficient Low Cost Engines
- Common Core 2nd Stage with expendable configuration

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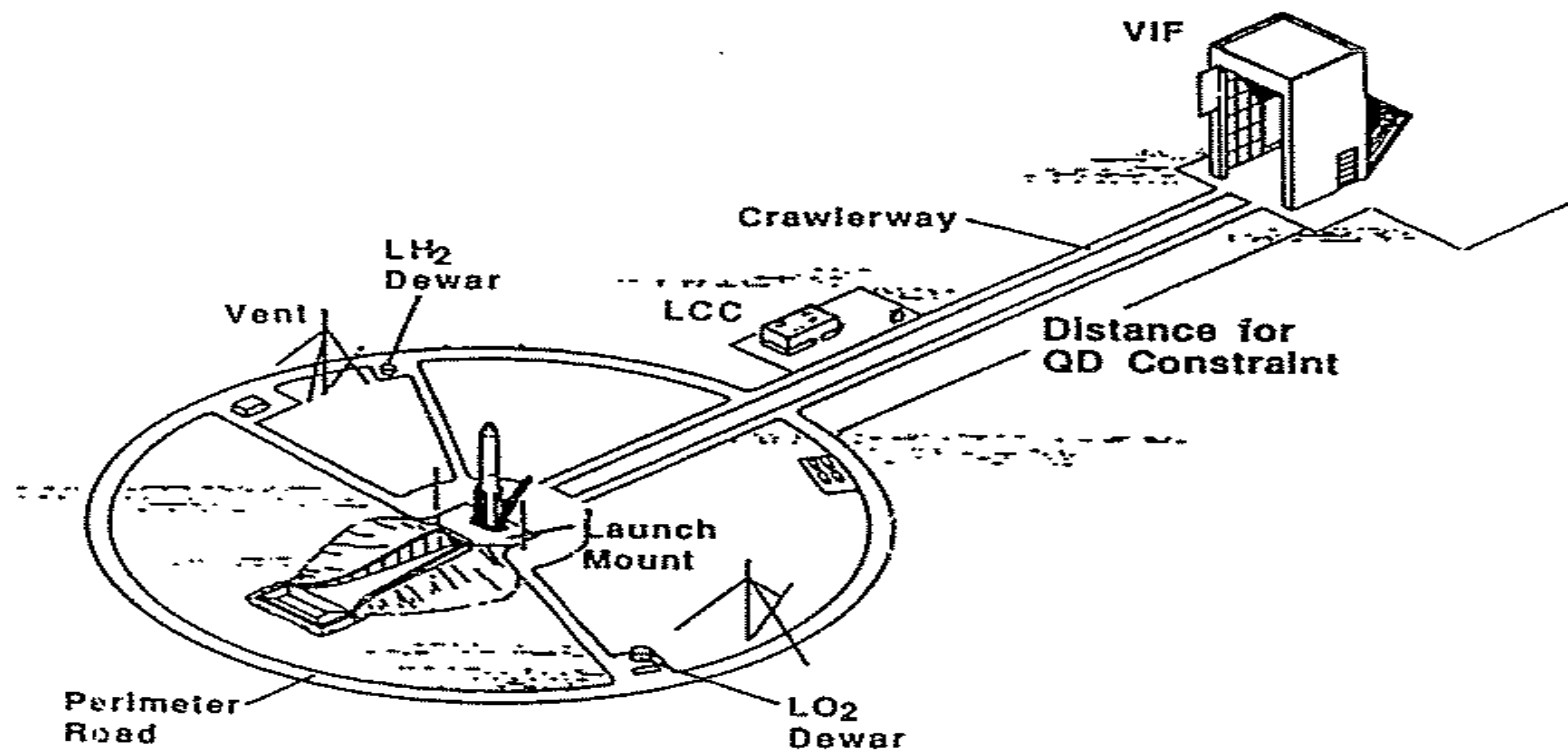
# ALS Operations Flow (Expendable)



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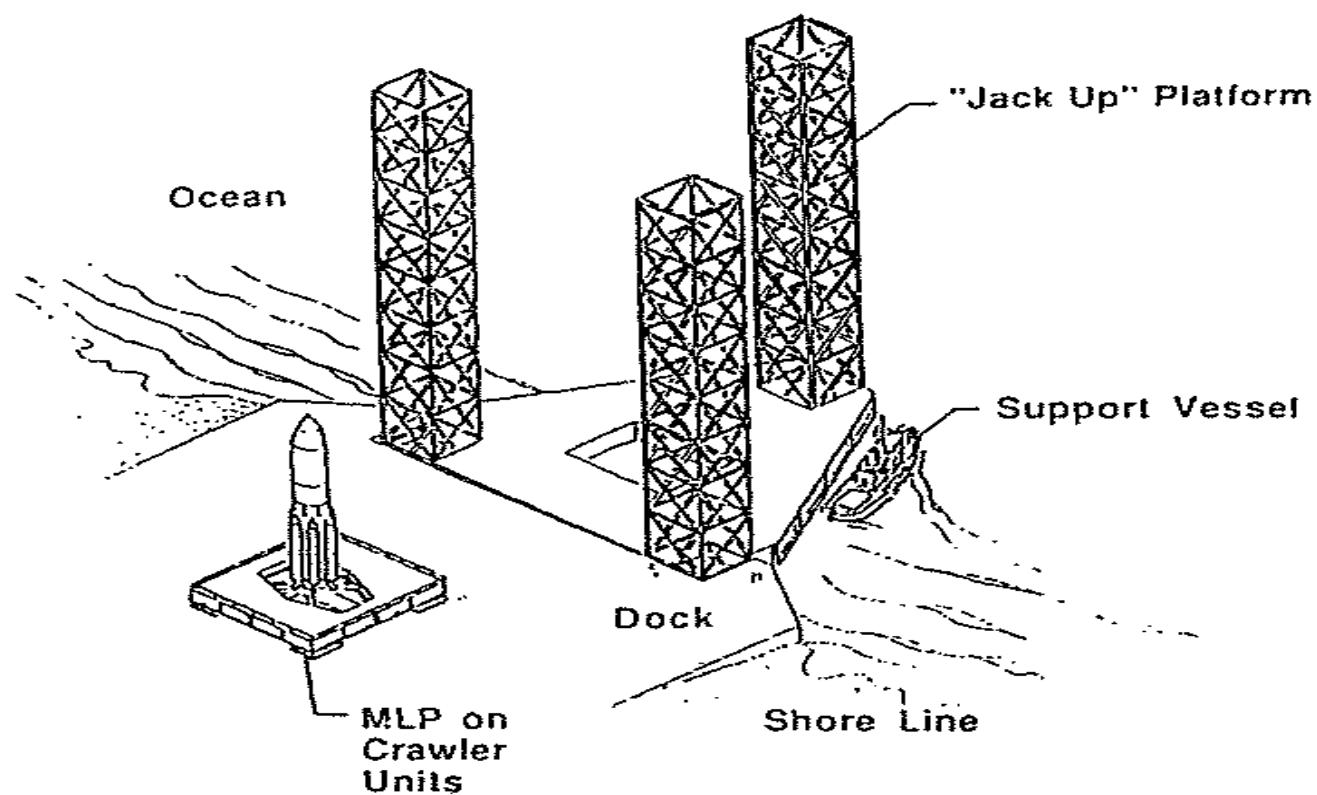
# Generic Launch Pad — Land Based

## Perspective



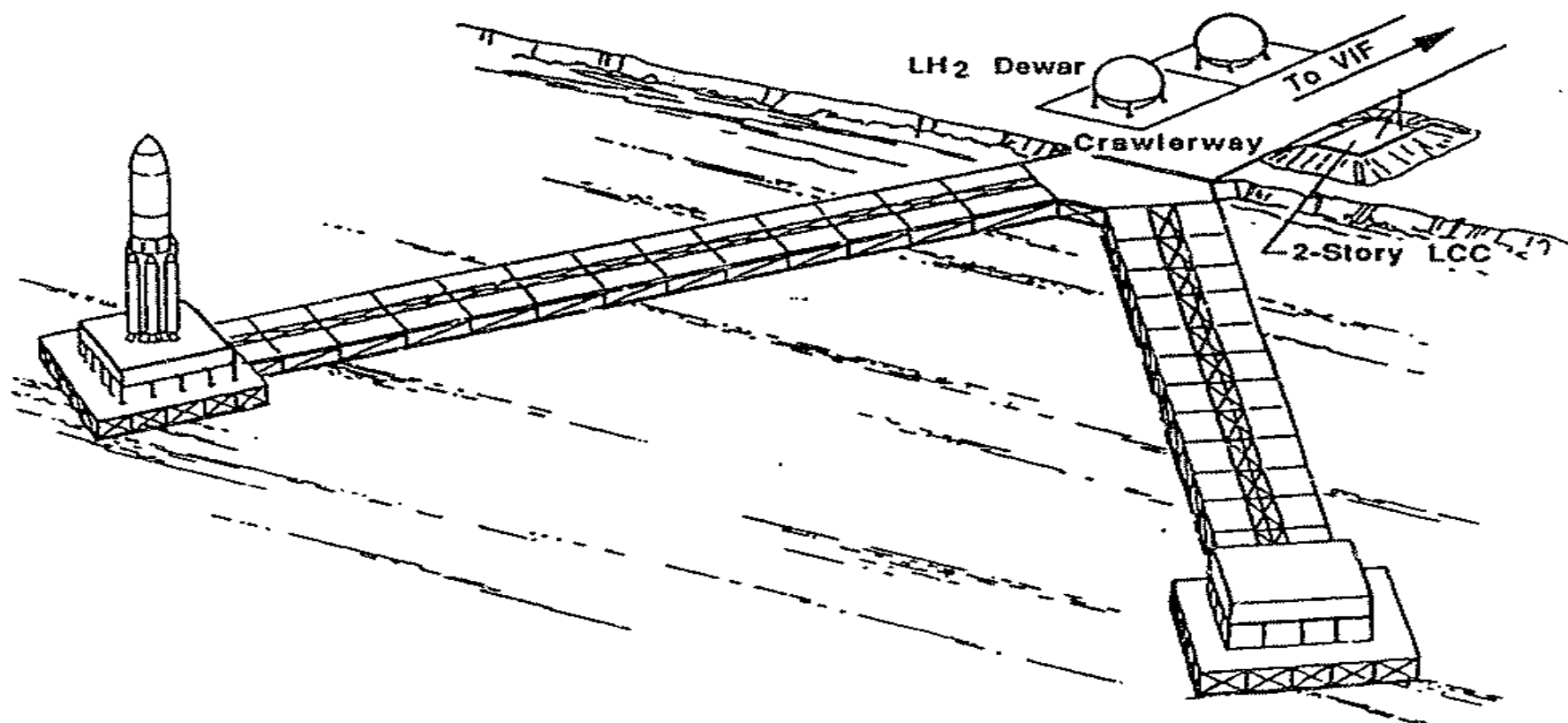
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## Generic Launch Platform — Sea Based



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## Generic Launch Pad — Off-Shore

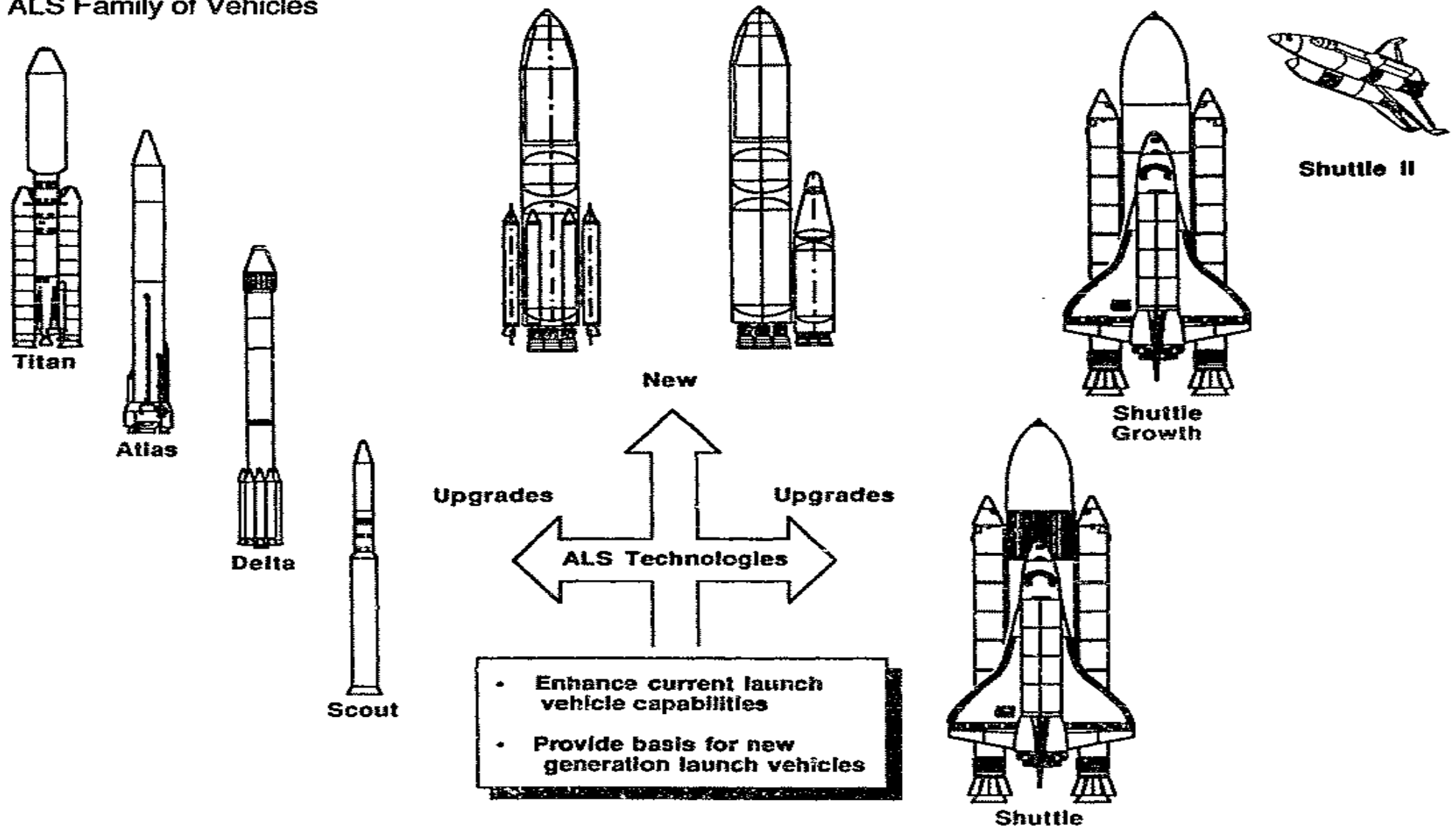


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# Application of ALS Technologies

## ALS Family of Vehicles



## **ALS Technology Infusion Potential**

| <b>Technology</b>                                      | <b>Titan II</b> | <b>Titan IV</b> |
|--|-----------------|-----------------|
| Advanced Data Base Technology                          | Low             | Medium          |
| Automated Launch Processing                            | High            | High            |
| Automated Launch Vehicle Integration                   | High            | High            |
| Ground Operations Flow Management                      | Low             | Low             |
| Load Cycle Simplification                              | High            | High            |
| Mission Analysis Simplification                        | High            | High            |
| Reusable Flight Software Library                       | High            | High            |
| Development and Manufacture of Advanced Cryogenic Tank | Low             | High            |
| Composite Structures                                   | High            | High            |
| Low Cost Thermal Protection                            | Low             | Low             |

## **ALS Technology Infusion Potential (cont)**

| <b>Technology</b>  | <b>Titan II</b> | <b>Titan IV</b> |
|--|-----------------|-----------------|
| Adaptive Guidance, Navigation and Control                    | Medium          | Medium          |
| Electromechanical Actuation with Integrated Electrical Power | High            | High            |
| Multipath Redundant Avionics Study                           | High            | High            |
| Expert System for Decision Aid Applications                  | High            | High            |
| Booster Recovery Module                                      | Low             | Low             |
| Expendable Structures  | High            | High            |
| Recovery and Refurbishment                                   | Low             | Low             |
| Vehicle Subsystems   | High            | High            |
| Automated Operations   | High            | High            |

# **Space Launch Systems**

October 19, 1988

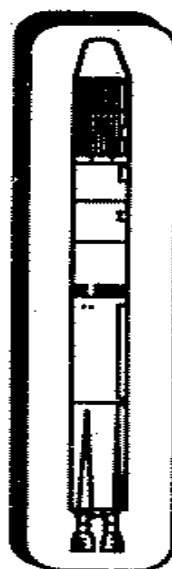
**A. C. Morrissey**

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# Operational Titan Launch Vehicles

Air Force launch vehicle for West Coast launches of small spacecraft.

Contract for refurbishment of fourteen Titan IIs through 1995.



**TITAN II**

Low earth polar orbit  
(100 nm x 100 nm)  
performance capability  
4,200 lbs

Maximum payload  
envelope  
9.3 ft dia x 30 ft long

Martin Marietta launch vehicle for East Coast launches of commercial and government spacecraft.

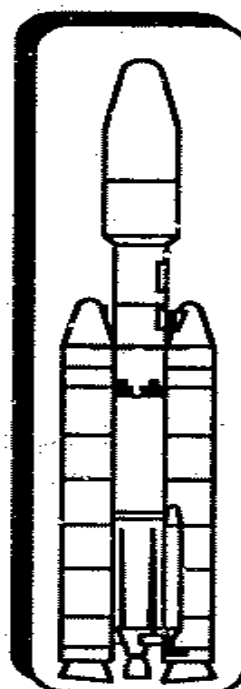
Three DOD Titan 34Ds in inventory. Final launch in 1989.

First commercial launch in 1989.

Geosynchronous transfer (Transtage, IUS, TOS) and low earth orbit missions (PAM-D, PAM-DII, SCOTS, integral)

Low earth orbit  
(80 nm x 140 nm)  
performance capability  
31,600 lbs

Maximum payload  
envelope  
12 ft dia x 47 ft long



**TITAN III**

Air Force launch vehicle for East and West Coast launches of large spacecraft.

Contract for 23 Titan IVs through 1993.

Centaur, IUS, and No Upper Stage missions

## East Coast

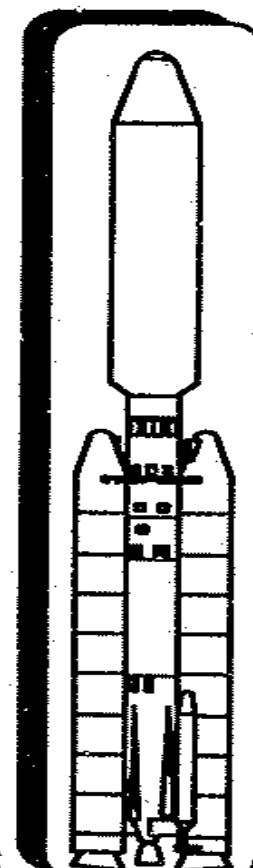
Geosynchronous orbit  
performance capability  
10,000 lbs (with Centaur)  
12,700 lbs (SRMU)

Low earth orbit  
(80 nm x 95 nm)  
performance capability  
39,000 lbs  
48,000 lbs (SRMU)

## West Coast

Low earth polar orbit  
(100 nm x 100 nm)  
performance capability  
32,000 lbs  
40,000 lbs (SRMU)

Maximum 15 ft diameter  
payload envelope - 61.7 ft  
long



**TITAN IV**

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# **Titan IV**

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# **Titan IV Overview**

**Customer :**

**Air Force Space Division**

**Program :**

**Build and launch twenty-three vehicles.**

**Initial Launch Capability:**

- Inertial Upper Stage - 4th quarter 1988
- No Upper Stage (CCAFS) - 1st quarter 1989
- No Upper Stage (Vandenberg) - 1st quarter 1990
- Centaur - 2nd quarter 1990

**Authority to Proceed :**

**February 28, 1985**

**Prime Contractor :**

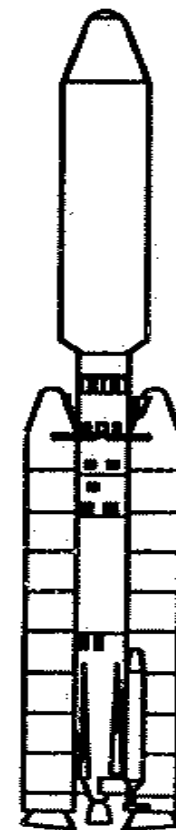
**Martin Marietta**

- Airframe
- Vehicle Integration
- Payload Integration
- Launch Operations

**Principal Subcontractors :**

**General Dynamics  
McDonnell Douglas  
United Technologies  
Hercules  
Aerojet TechSystems  
Delco Electronics  
SCI  
Cincinnati Electronics  
Analex  
Boeing**

- Centaur Upper Stage
- Payload Fairings
- Solid Rocket Motors
- Solid Rocket Motor Upgrade
- Liquid Rocket Engines
- Guidance
- Instrumentation
- Command Receivers
- Centaur Consultant
- Inertial Upper Stage

**Associate Contractor :**

**TITAN IV**

# Titan IV Program Summary

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## Program Status

- 23-vehicle program baseline; additional vehicle follow-on ATP early 1989
- Five configurations, two upper stages, and launch capability from both coasts

## Core Vehicle

- First flight vehicle on the launch pad
- Second flight vehicle delivered to Cape Canaveral

## Liquid Rocket Engines

- First five systems complete
- Two systems shipped to Cape Canaveral

## Solid Rocket Motors

- Reviews and testing complete
- First flight motors stacked and mated to core

## Solid Rocket Motor Upgrade

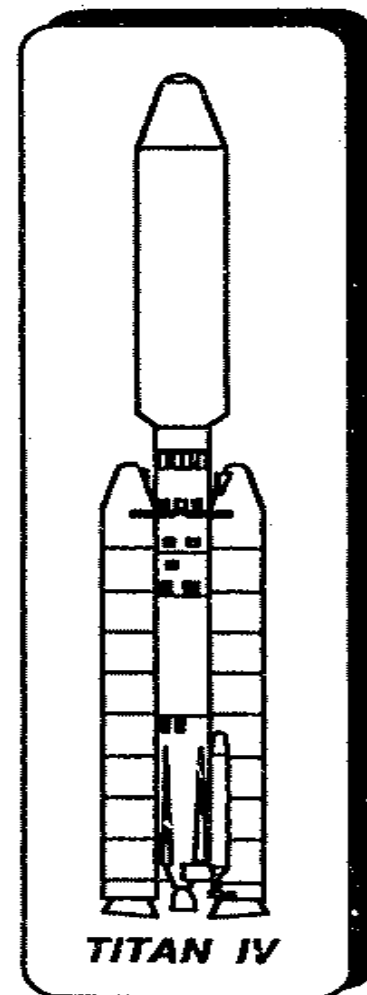
- First full-scale case winding complete
- Preliminary Design Review scheduled October 1988

## Payload Fairing

- Two units delivered to Cape Canaveral
- First flight unit in launch site processing

## Centaur

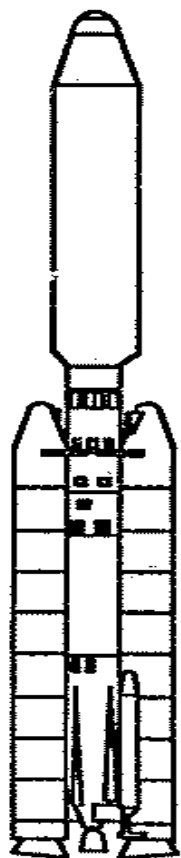
- Tank design complete, test tank in major weld
- Qualification/design evaluation tests in progress



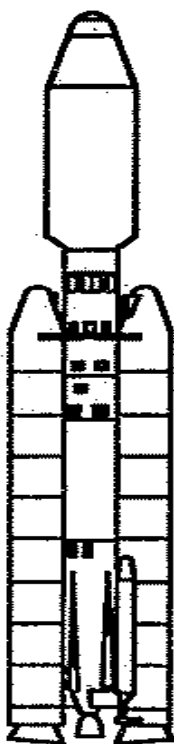
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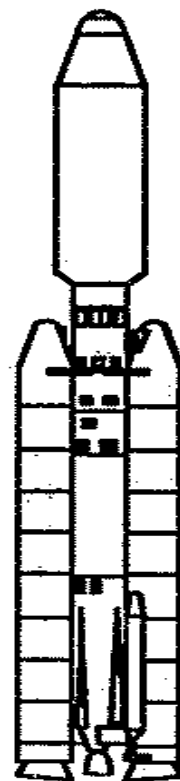
# Titan IV Configurations



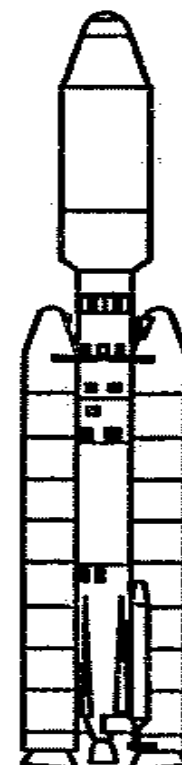
East Coast  
(Centaur)



East Coast  
(Inertial Upper Stage)

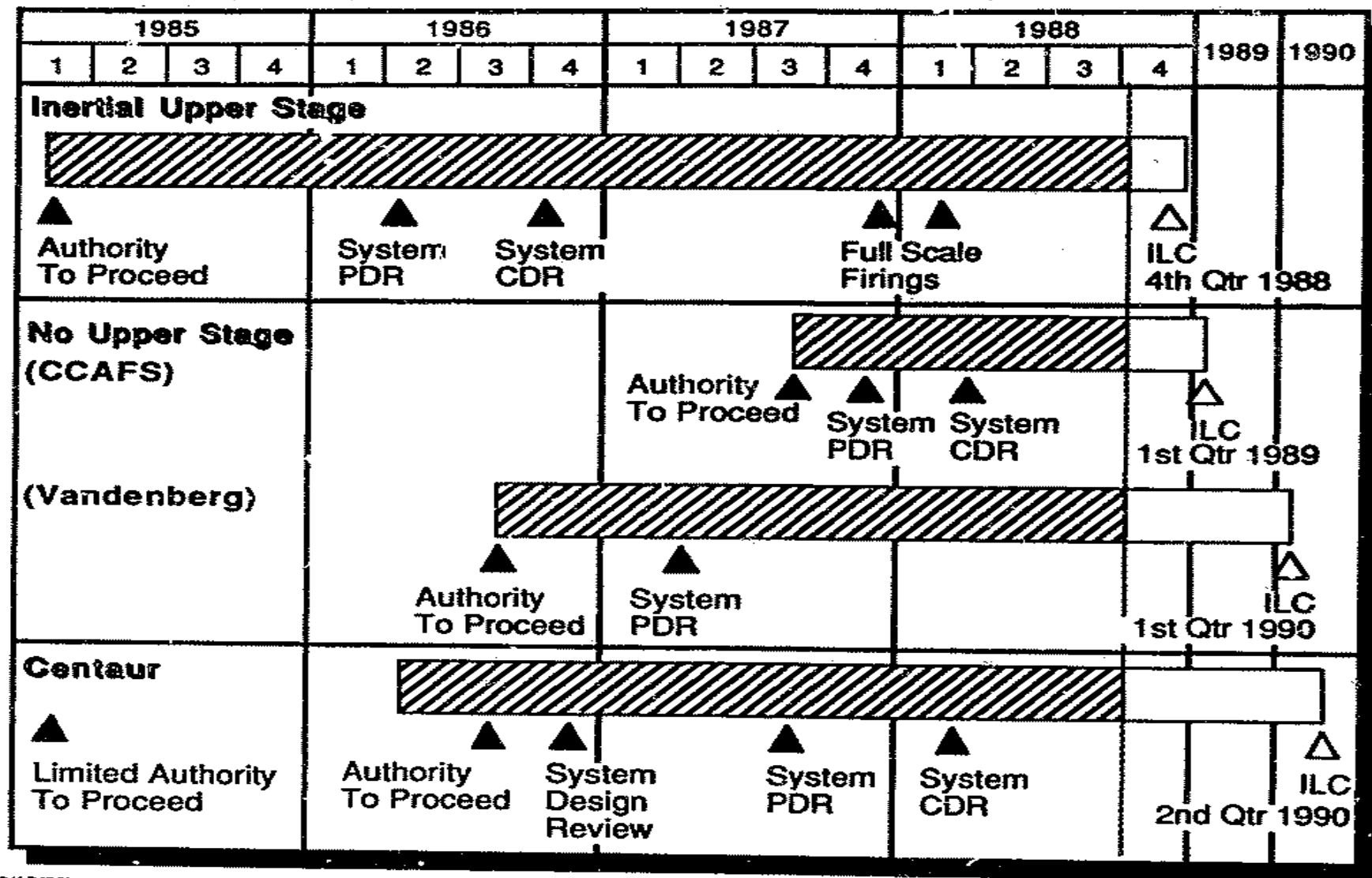


West Coast /  
East Coast  
(No Upper Stage)



West Coast  
(No Upper Stage /  
Titan Payload Adapter)

# Titan IV Summary Schedule



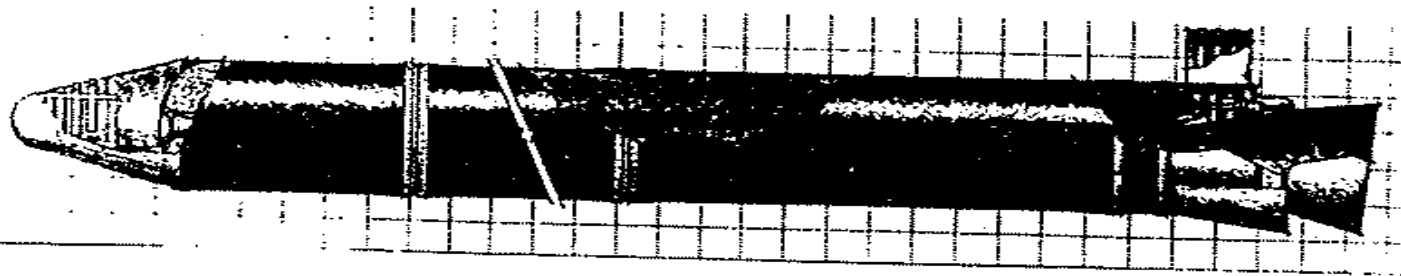
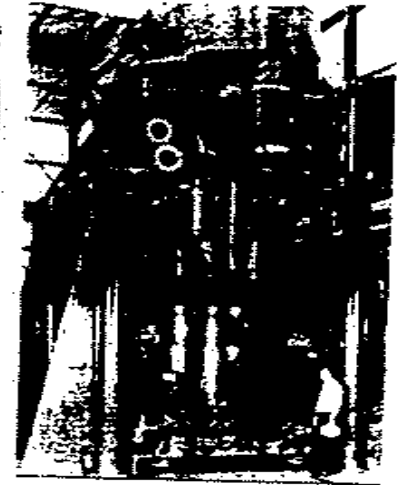
# Titan IV Launch Availability

| 23-VEHICLE PROGRAM   | 1988 |   |                           |   | 1989                      |   |   |        | 1990                      |   |        |         | 1991    |         |         |         | 1992    |         |         |   | 1993    |         |   |   |
|----------------------|------|---|---------------------------|---|---------------------------|---|---|--------|---------------------------|---|--------|---------|---------|---------|---------|---------|---------|---------|---------|---|---------|---------|---|---|
|                      | 1    | 2 | 3                         | 4 | 1                         | 2 | 3 | 4      | 1                         | 2 | 3      | 4       | 1       | 2       | 3       | 4       | 1       | 2       | 3       | 4 | 1       | 2       | 3 | 4 |
| CCAFS                |      |   |                           |   |                           |   |   |        |                           |   |        |         |         |         |         |         |         |         |         |   |         |         |   |   |
| Inertial Upper Stage |      |   | 1<br>△<br>4th Qtr<br>1988 |   |                           |   |   |        | 6<br>△                    |   |        |         |         | 14<br>△ |         |         |         |         |         |   |         | 22<br>△ |   |   |
| No Upper Stage       |      |   |                           |   | 2<br>△<br>1st Qtr<br>1989 |   |   | 3<br>△ |                           |   |        |         |         |         |         |         |         |         |         |   |         |         |   |   |
| Centaur              |      |   |                           |   |                           |   |   |        | 5<br>△<br>2nd Qtr<br>1990 |   | 8<br>△ | 10<br>△ | 11<br>△ | 13<br>△ | 16<br>△ | 17<br>△ | 18<br>△ | 19<br>△ | 20<br>△ |   | 23<br>△ |         |   |   |
| <hr/>                |      |   |                           |   |                           |   |   |        |                           |   |        |         |         |         |         |         |         |         |         |   |         |         |   |   |
| Vandenberg           |      |   |                           |   |                           |   |   |        |                           |   |        |         |         |         |         |         |         |         |         |   |         |         |   |   |
| No Upper Stage       |      |   |                           |   |                           |   |   |        | 4<br>△<br>1st Qtr<br>1990 |   | 7<br>△ | 9<br>△  |         | 12<br>△ | 15<br>△ |         |         |         |         |   | 21<br>△ |         |   |   |

\* Upper Stage to be determined

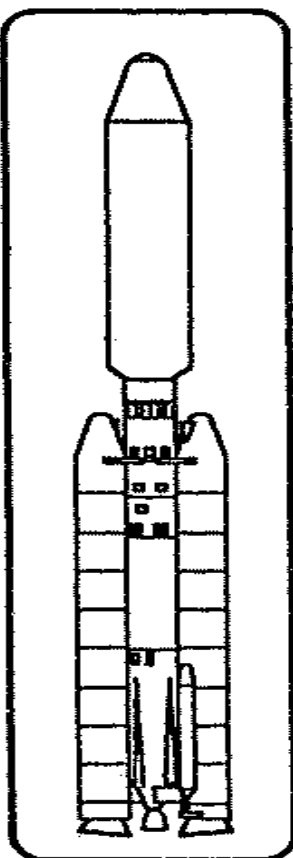
# Titan Solid Rocket Motor Upgrade

- 100 Titan-Scale Graphite Cases Made with Hercules Graphite
- Automated Insulation Application
- Titan Propellant Scaled to 1800-gallon Mixer—April 30, 1987
- Synergistic Designs



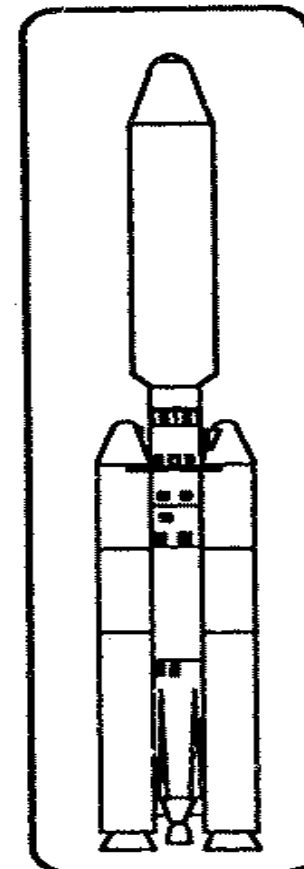
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# SRMU Performance Enhancement



**Titan IV  
7-Segment  
Solid Rocket  
Motor**

| <i>Specification Requirement</i> |                                      |                   |
|----------------------------------|--------------------------------------|-------------------|
| <b>7-Segment SRM</b>             | <b>Reference Missions</b>            | <b>SRMU</b>       |
| 32000 lbs                        | West Coast<br>100 nmi x 100 nmi      | 40000 lbs<br>+25% |
| 10000 lbs                        | East Coast<br>Geosynchronous Payload | 12700 lbs<br>+27% |
| 38784 lbs                        | East Coast<br>80 nmi x 95 nmi        | 48300 lbs<br>+24% |



**Titan IV  
Solid Rocket  
Motor Upgrade**

**MARTIN MARIETTA**

# **Titan IV Summary**

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## **Primary access to space for critical national defense programs**

- Program expanded to 23 vehicles
- Follow-on buy proposal initiated

## **System design baselined**

- System Critical Design Review completed

## **Program development and activation progressing**

- First flight vehicle in launch processing

## **Product Improvement Program Initiated**

- Solid Rocket Motor Upgrade design progressing

# **Titan II**

**MARTIN MARIETTA**

# Titan II Overview

**Customer:**

Air Force Space Division

**Program:**

Refurbish fourteen Titan II ICBMs for space launch capability

- Launch complex refurbishment
- Contract funding for three launches per year - Vandenberg only

**Authority To Proceed:**

January 1986

**Prime Contractor:**

Martin Marietta

- Airframe Refurbishment
- Assembly and Test
- Launch Operations

**Principal Subcontractors:**

McDonnell Douglas  
Aerojet TechSystems  
Delco Electronics  
SCI  
Cincinnati Electronics

- Payload Fairings
- Liquid Rocket Engines
- Guidance
- Instrumentation
- Command Receivers



**TITAN II**

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